

## **Sub-wavelength metallo-dielectric photonic crystals<sup>#</sup>**

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The optical properties of a sub-wavelength metallo-dielectric photonic crystal are simulated with a rigorous S-matrix (scattering matrix) theory. The S-matrix approach simulates the reflection and transmission through this structure by solution of eigenmodes within each layer. We calculate the optical properties of a sub-wavelength array of holes in a metal layer on a photonic crystal. These show sharp resonant absorption and equivalently resonant emission modes, at wavelengths close to the lattice spacing. The resonances are characterized by an enormous enhancement of the fields within the sub-wavelength apertures with maxima near the edges of the holes and minima in the interior of the apertures. Simulations for different structural geometries illustrate the nature of the resonant absorption in the sub-wavelength structure and the role of surface plasmon modes at the interfaces.

Simulations provide an understanding of these unusual resonances. Calculations for a thin metal layer with a sub-wavelength array of holes exhibit the well-known extraordinary transmission peaks. Simulated reflection and transmission for photonic crystals (without metal coatings) exhibit guided resonances for out-of-plane propagation which compare well with measurements on silicon photonic crystals. Both sets of resonances combine together to generate the unusual absorption of the metallo-dielectric photonic crystal. Applications to tunable infrared sensors will be discussed by I. Puscasu et al [1]. Alternative approaches of photonic crystals to wavelength determination will be briefly surveyed.

[1] I. Puscasu et al, abstract submitted to this PECS-VI meeting.

# Supported by the NSF under grant DMR-0346508.